SOIL SURVEY OF AS
ADAMS COUNTY
PENNSYLVANIA


SOIL MAP
SHIPPENSBURG
SOUTHAMPTON
MENALLEN
FRANKLIN
HAMILTONBAN
STRABAN
TYRONE
HUNTINGTON
MOUNTJOY
LIBERTY
FREEDOM
WASHINGTON


FRANKLIN
WASHINGTON
HUNTINGDON
READING
TYRONE
BUTLER
HAMILTON
STERLING
BERWICK
MONTEREY
PLEASANT
PENN
WEST MANHEIM
LEGEND

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS

SOIL SURVEY

of

ADAMS COUNTY PENNSYLVANIA

By

A. L. PATRICK and H. H. BENNETT

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1924


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SOIL SURVEY *of* ADAMS COUNTY, PA.

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INTRODUCTION.

In 1904 a soil survey of Adams County was made by the Bureau of Soils, United States Department of Agriculture.[1] At this time soil survey work was in its infancy—the beginning of a new branch of soil science. Actual field mapping had begun only five or six years prior to this time, and no great amount of experience with the diversified soils of the country had been acquired. There were no long-established standards to guide the surveyors in their field work; indeed, in these early years the standards were being created through the accumulation of field and laboratory experience. At first it was not the easiest thing to decide just how far to carry the details of type separation, or just what should be the smallest area of a given soil to delineate on the soil map. Until this time there had been no workable scientific classification of the soils based upon actual and significant soil differences, such as texture, structure, color, source of material, and marked chemical characteristics, and drainage. The soils were generally vaguely designated with such indefinite and unsatisfactory terms as "ironstone land," "copperstone land," "sandy land," "loam," "pipe clay," and so on. Some persons still employ these designations, making little attempt to familiarize themselves with the definite types which have been identified and defined and which are being mapped throughout the country.

At the present time the soils of the country are much better understood, and the mapping is being done with much more refinement than in 1904. Many more groups of soils are recognized and mapped than formerly.

So this reconnaissance map is based upon more matured soil experience and knowledge. A detailed survey would show, of course, a number of soil types not indicated on the reconnaissance map, and very much more detail as to the precise distribution of the soils, showing the smaller areas as well as the larger ones.

The recent geological map was of great assistance in making the soil map, the distribution of the rocks having a close relation to the distribution of the soils, as pointed out farther on.

Principal Farm Products.

The present dominant type of agriculture in Adams County is general farming. In many sections dairy farming or the feeding of

[1] Field Operations, Bureau of Soils, U. S. Dept. of Agriculture, 1904 pp. 117-150—map accompanying.

beef cattle is combined with general farming. Poultry raising is of considerable importance, though there are few exclusively poultry farms. Fruit growing is very important. Adams County stands first in the State in the production of apples.

The following table taken from the 1920 census report shows the acreage devoted to each of the important field crops, together with the total and average yield in 1919:

Crops produced in Adams County in 1919.

Crops	*Acres*	*Yield*	*Yield per acre*
Hay and forage ..	87,014	108,991 tons	1.25 tons
Wheat	57,820	911,809 bu.	15.8 bu.
Corn	45,487	2,244,897 "	49.3 "
Oats	13,066	292,201 "	22.4 "
Rye	4,730	54,527 "	13.7 "

The total value of the hay and forages crop was $1,964,516. Timothy and clover mixed and timothy alone make up the greater portion of the hay. A very small acreage, however, is devoted to clover alone, and to alfalfa. The most important forage crop is corn. The hay and forage crops are subsistence crops, being fed for the most part on the farms where grown. The total value of the cereal crops in 1919 was $5,917,785. Wheat is the chief money crop. Corn and oats are used principally as subsistence crops, the surplus only being sold. A small acreage is devoted to barley, rye, and buckwheat.

Adams County is the leading apple county in Pennsylvania. In 1919 the total value of all fruits and nuts amounted to $1,936,376. Apples made up most of this sum. The 1920 census report gives a total of 254,228 apple trees of bearing age, producing 742,196 bushels of apples in 1919. In addition there were 280,355 trees not of bearing age. The recent "Apple Survey" made by the State Department of Agriculture shows that in the planted orchards the following varieties are most important: (1) York Imperial; (2) Stayman Winesap; (3) Ben Davis; (4) Grimes Golden; and (5) Jonathan. In the proposed orchards the order of varieties to be planted will be (1) Stayman Winesap; (2) York Imperial; (3) Grimes Golden; (4) Jonathan; and no Ben Davis. In 1919 there were 141,278 bearing trees.

Peaches are important. They are grown as fillers in apple orchards and as the latter develop the peach trees are cut out. Many of the more recently planted apple orchards do not contain peach trees. They are not as sure a crop as apples in this climate, which partly accounts for the greater popularity of apples. Cherries come next to peaches in popularity among the tree fruits, with 21,061 bearing trees in 1919. Pears, plums, grapes and berries occupy only a very limited acreage and are found for the most part only in the home gardens.

Vegetables are not important except in the vicinity of Littlestown, where the farmers make a specialty of growing sweet corn and peas. Potatoes, however, are grown on a large scale throughout the county by many farmers producing the general farm crops. Nearly all farms produce sufficient vegetables to supply the home table.

Dairying is followed by many farmers, especially near the railroad in the eastern half of the county. In 1919 there was a total of 19,249 dairy cattle of which 12,564 were cows and heifers two years old and over. The most popular breed is the Holstein, then the Guernsey. The number of cows per farm in the dairy sections averages about ten to twelve. The milk is shipped to Baltimore, Washington, Philadelphia, and Harrisburg.

Many farmers feed steers during the late fall and winter months. This business is confined to the lowland sections in the eastern portion of the county. Some of the farmers are using silage as part of the ration. The 1920 census reports about 7,000 beef animals over one year old. Poultry and hogs are raised in sufficient quantities to supply local demands for pork and poultry products. The surplus of these products is sold, and the receipts greatly increase the returns from the farm. The total value of poultry in 1919 was $494,365, and the receipts from the sale of chickens and eggs amounted to $995,608. The total number of swine in the county the same year was 33,393, or an average of about 9 per farm, the value of which was estimated at $603,167.

A few sheep, horses, and mules are raised but in such limited numbers as to be relatively unimportant.

Efficiency in Farming.

Generally methods of farm management in Adams County are efficient, especially on the better types of soil and in connection with the specialized industries, the growing of apples and peaches in particular. Good deep plowing is done and considerable attention is given to the preparation of a seedbed of desirable tilth; cultivation is performed thoroughly and timely; modern farm implements are coming into general use; the farm buildings are prevailingly substantial and provide satisfactory housing facilities; efficient soil-building rotations are practiced; soil adaptation to crops is practiced to a considerable degree; and fruit trees are promptly sprayed and looked after. Of course there are inefficiently operated farms here and there, where the soil has been allowed to become impoverished by failure to keep up the humus supply; where steep slopes have been allowed to wash, instead of being put to grass or devoted to farm wood lots; where the buildings have been allowed to get out of repair, and so on. But, on the whole, farm practice has improved considerably during the past present century.

In this connection it is interesting to read Wilder's appraisal of conditions in the county in 1904:[2]

"The prosperity of the farming class of Adams County bears a close relation to the soil types upon which the farms are located. Farms situated on the lime-stone soils, the Penn loam,[3] the least shaly parts of the Penn shale loam, and the copperstone phase of the Porter clay,[4] have in most cases, the appearance of prosperity, while on the other soils the prosperous farms constitute a minority. It is said that fifteen years or more ago the majority of the farmers were prosperous, and many became well to do; but since that time the profits have greatly diminished until the last two or three years, when there has been a slight tendency toward improvement of conditions.

"The ownership of farms also has much to do with the prosperity of local agriculturists. The best farmers, who live on and till their own land, are notably thrifty, and by dint of rigid economy and remarkably long working hours for themselves and families secure a good rate of interest on their investment besides the living expenses of the family. Men who rent their farms seldom get a rate of interest on their investment equivalent to that paid by savings banks, and only an occasional tenant has anything left after paying the living expenses of himself and family."

The farmers attempting to grow the general-farm crops on the less favorable soils, such as the very stony lands and the steep slopes susceptible to erosion, are confronted by the difficult problem of succeeding against the odds of soil misuse; and even the most industrious may fail under such circumstances, and certainly they can scarcely hope to show much profit for their labor.

The topography and character of the soil have largely determined the type of farming in the different sections. The high portions of South Mountain, consisting for the most part of Dekalb stony loam, are not developed and, with the exception of an occasional small clearing, are covered with forests. This stony land is better adapted to forestry than to anything else. The eastern slopes of South Mountain are valued for apple and peach growing purposes. The most popular soils for these fruits are the Porters gravelly silt loam, The Penn gravelly loam, and the Ashe gravelly silt loam. The stony types of Porters and Ashe are found on the steeper portions of the slopes and have not been cleared. Three types of soil, the Penn silt loam, Lansdale silt loam, and Hagerstown silt loam, occupy most of the more gently sloping areas east of the South Mountain foot hills and are prized especially for the production of the general-farm

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[2] Wilder, Henry J., Field Operations, Bureau of Soils, U. S. Dept. of Agriculture, 1904, p. 146.

[3] Includes much Penn silt loam.

[4] In the recent classification this type includes Porters gravelly loam, and some loam or clay, and, in addition, Ashe gravelly loam.

crops, corn, oats, wheat, and hay. The only important vegetable-producing section is located in the extreme southeastern part of the county on the Manor slate loam.

Cultivation.

Corn follows sod, which is usually manured before plowing. The sod is plowed either in the late fall or early spring. Fall plowing seems a little more desirable. The crop is cultivated from 3 to 5 times during the season. Yellow dent varieties are the most popular. Among the best varieties for grain are Lancaster Sure Crop and Reids Yellow Dent, while Boone County White and Clouds Yellow Dent are excellent silage varieties.

Wheat land is plowed late in the summer and early in the fall. The seed is drilled sometime between the middle of September and the middle of October. The usual time of seeding is about September 25th, except after seasons when the Hessian fly has been very troublesome, when the sowing is done at a later date. Timothy is usually sown in the drill with wheat; clover is broadcasted on the wheat early the following spring. Varieties of wheat well suited to this county are Miracle, Fulcaster, Pennsylvania 44, and Lancaster.

Oat land is usually plowed in the spring, and the crop is drilled in early April. The Sixty Day variety is a very good one for this section.

The recent apple survey made by the State Department of Agriculture shows that about one-half of the apple orchards remain in sod at least three years out of every seven and that on the other half a clean-cultivation-and-cover-crop system is practiced. The following crops are the most important as cover crops, given in the order of importance: (1) clovers (including crimson and common red); (2) weeds; (3) mixed legumes and non-legume crops; (4) mixed legumes; and (5) rye. The orchards are sprayed and pruned regularly.

The farms are well equipped. Buildings are substantial and adequate, many of them being made of stone or brick. The bank-barn is rather common. Corn cribs, wagon sheds and garages are found on many farms as separate buildings from the barn. Silos are becoming more numerous each year. In 1919 they numbered 263. A few farmers own tractors. The machines are becoming popular in the fruit-growing sections, as well as in the general-farming regions. Horses and mules still furnish most of the power. They are large and well kept. Nearly every farm is well equipped with efficient tillage implements and the orchard men have modern power sprayers. The total value of farm machinery in 1919 was $3,044,281 or an average of $879 per farm. The total value of farm buildings the same year amounted to $9,784,391 or $2,815.00 per farm, and the average value of all livestock per farm was $1,377.

Crop Rotation.

The general-farm crops are grown in rotations. Among the most common is the Pennsylvania four or five year rotation: Corn, followed by oats, and oats by wheat, and this crop by clover and timothy mixed to stand one or two years. Many farmers are making a practice of plowing down the sod at the end of the first season for corn and potatoes, thus making a four year rotation. Some seed clover alone. Many further modify the rotation by growing corn one year, wheat two years, then clover or clover and timothy, thus eliminating the rather unprofitable oat crop. A three year rotation of corn—wheat—clover is rather popular, although where the corn is grown for grain it is sometimes necessary to drill wheat a little later than it is usually drilled. A rotation which may be found more desirable than the common scheme of crop succession is corn—soy beans—wheat—clover. Timothy is usually sown with clover in most of the rotations, even though the grass is cut but one year. Some dairymen find it advisable to practice a corn—corn—wheat—clover rotation, in which case the second crop of corn is usually grown for silage.

Fertilizing.

The 1920 census report shows that approximately $128 was spent per farm in 1919 for fertilizer. Ninety-seven per cent of the farmers use commercial fertilizer. The majority of the farmers buy a rather low grade "complete" fertilizer, such as 2-8-2[5]. It is used on nearly all crops in quantities ranging from about 150 to 300 pounds an acre. Wheat usually receives more than corn; oats are often unfertilized. Many of the more progressive farmers are fertilizing corn which has received an application of manure, or which follows a good sod, with from 250 to 400 pounds of acid phosphate per acre. Oats receive about 200 pounds of the same fertilizer. Wheat that has received manure is also fertilized with acid phosphate at a somewhat higher rate than that applied to corn, especially where the grain serves as a nurse crop for clover and timothy. Those who do not have manure to apply to the wheat use a high grade "complete" fertilizer, such as a 2-10-2 or 2-12-2 mixture. The potato growers use from about 600 to 1,000 pounds of acid phosphate per acre on good land that has received a liberal application of manure and many are using a large quantity of a high grade commercial fertilizer, such as a 4-8-4 or a 4-8-6 mixture. The fruit growers use a fertilizer high in available nitrogen or else straight nitrate of soda.

Lime is used by many farmers when clover begins to run out. It is usually applied on the plowed ground and harrowed in before drilling wheat. The value of lime used in the county in 1919 was $42,900.

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[5] 2-8-2 means 2 per cent ammonia, 8 per cent phosphoric acid, and 2 per cent potash.

Hired Labor.

In 1919 the average cost of hired labor per farm in Adams County amounted to $236; counting in the subsistence the average cost of labor per farm was $300. Labor is not very plentiful, most of it being supplied by native-born whites, though some colored labor is found, especially near the Maryland border of the county.

Ownership and Size of Farms.

In 1919 there were 3,451 farms in Adams County, of which 2,339 were operated by the owners, 156 by managers, and 956 by tenants. Of the latter, 829 were share tenants (paying rent for land by giving a certain part of crops to owner), 9 were share-cash tenants, that is paying some money and some produce, and the remaining 118 were cash tenants. The size of the farm varies considerably. Many of the farmers in the western portion of the county have several hundred acres, of which only a small portion is improved. The truck and many of the fruit growers have a smaller acreage than do the general farmers. The average size of a farm in 1919 was 80.9 acres, of which 63.3 acres were claimed as improved land in farms.

The recent census report gives the total farm area as 279,163, representing 82.6 per cent of the county, of which 78.2 per cent is improved.

Value of Farm Land.

The value of farm land varies considerably in Adams County, depending upon the fertility; distance from good markets, good roads, and shipping stations; and especially upon the improvements and type of farm. The average acre value in 1919 was $46.18, though this figure tells one very little, since it includes all grades of land from the best to the steepest, stony land. Good general-farm land often sells for over $100 an acre, while well cared-for, mature apple orchards bring several hundred dollars an acre.

The local markets in Adams County are poor. Gettysburg, the county seat and the largest town, has a population of about 5,000. It has very few industries. Many tourists visit the town in summer to see the Gettysburg battlefield. Gettysburg College, a very old college, is located here.

Markets.

Besides Gettysburg, there are a number of small towns among which Littlestown, New Oxford, East Berlin, Fairfield, Idaville, Bermudian, York Springs, Bendersville, Biglerville, Floradale, Abbottstown, Orrtanna, Arendtsville, and Aspers are the most important. Several evaporating plants are located in the fruit-growing section in the north-central part of the county. Many of the small towns on the railroad in the eastern part of the county have milk-receiving sta-

tions, and Littlestown in the heart of the vegetable growing center has a cannery which makes a specialty of canning peas and sweet corn.

Two branch railroad lines connect Adams County with Harrisburg, 46 miles distant; and with York, 25 miles away; Philadelphia, 108 miles; Baltimore, 53 miles; and Washington, 74 miles. Freight rates are high. It is thought by those who have studied the situation that the logical markets for the county are Baltimore and Washington, for Adams County farmers cannot compete to an advantage with many other growers in the Harrisburg and Philadelphia markets. Roads are excellent and some farmers have proved that it is possible to place their products in Washington and Baltimore cheaply by automobile truck. The future will probably see this method of marketing used on a large scale.

SOILS.

The greater portion of Adams County lies in the Piedmont and Appalachian Provinces. The soils of the uplands owe their origin to the weathering of the underlying rocks. These can be broadly classed as (1) crystalline-igneous and metamorphic rocks; and (2) sedimentary rocks. The crystalline rocks include quartzite, metarhyolite, metabasalt, diabase, slate, and schist, as well as narrow belts of sericite schist and vein quartz. These rocks, because of their hardness, have not eroded as rapidly as have the softer sedimentary rocks, and, consequently, they form the base of many of the higher elevations in the western and north-central portions of the county. The highest portions of South Mountain (Piney and Green mountains) are made up of Cambrian formations,[6] the main portions of which are quartzites and interbedded schists, with some Cambrian sandstone, shales, and dolomitic limestone. Pigeon Hill near the east-central border of the County is of similar formation. The eastern portions of South Mountain are underlain by Algonkian formations of which metarhyolite (altered rhyolite) makes up the main body, but containing, also, numerous narrow belts of metabasalt (altered basalt), rhyolitic breccia, sericite schist, and vein quartz. Some of these same rocks are found in the Pigeon Hill district in the eastern part of the county. In the eastern half of the county, or Piedmont section, the coarse-grained Triassic trap or diabase ridges stand above the general level of the country. In the extreme southeastern corner, the highlands country is underlain by slate and schist of unknown age.

[6] The geological terms, formation names, etc., in this chapter are based on the recent geological survey of the region made by George W. Stose of the United States Geological Survey. This chapter is chiefly concerned with broad soil differences and processes of soil development. It is, therefore, of more interest to the technical student of soils than to the farmer. The agriculturist is more concerned with the soil types discussed in the following chapters.

The Triassic sandstones, shales, and conglomerates constitute the greater portion of the sedimentary rocks, although, locally, the Cambro—Ordovician limestones, sandstones, and shales are important. In addition, unconsolidated gravel and sand of recent origin occur along many of the larger streams.

Derivation.

The residual soils of the area are derived from the underlying rocks, and the alluvial soils from the water-laid stream deposits. The residual soils have a close relation to the parent rock, at least to the extent that the distinct kinds of rock give rise to distinct kinds of soil. Differences in process of weathering, as influenced by differences in the drainage, have caused the development of different kinds of soil from the same parent rock, as, for example, the Penn soils (named for the locality where first mapped) a well drained group of soils, and the Croton, a poorly drained group, are both derived from the chocolate-red sedimentary rocks of Triassic age.

The soils can be broadly grouped into soil provinces according to geologic origin, mode of formation, and topographic position. The provinces, or natural soil regions, are further divided into soil series, on the basis of the structure (degree of looseness, compactness, plasticity, etc.) of the soil through the vertical section, the color, the rock origin, and the drainage characteristics.

The types, the units of soil classification, are separated on the basis of texture and the content of stone and gravel, the several series including one or more of such types as sandy loam, fine sandy loam, loam, silt loam, silty clay loam, clay loam, clay, stony sandy loam, shale loam, gravelly loam, and so on. Soil phases are separations of minor or local importance within the type, and are shown on the map by symbols.

Thus we have the following types in the Penn series in Adams County: The Penn gravelly loam, the Penn silt loam, the Penn loam, and the Penn shale loam. In the Hagerstown series only one type has been mapped, the Hagerstown silt loam, but there have been recognized in addition two phases: (1) The Hagerstown silt loam, yellow subsoil phase, and (2) the Hagerstown silt loam, colluvial phase. A more detailed survey probably would show on the soil map other types, such as occur in areas too small to be given much consideration in a reconnaissance survey.

The genetic relationship of the various soils to the geological formations is shown in the following outline; and the Province distribution of the types is also shown.

OUTLINE SHOWING APPROXIMATE GENETIC RELATION[7] BETWEEN GEOLOGICAL FORMATIONS AND SOIL TYPES.

RESIDUAL SOILS

Formation[8]		Soil Province	Soil Type
Antietam sandstone	Higher 1. elevation	Appalachian Mountain and Plateau	Dekalb stony loam
Harpers shale	Higher 1. elevation	Appalachian Mountain and Plateau	Dekalb stony loam
Montalto quartzite	Lower 2. elevation	Piedmont Plateau	Herndon gravelly loam (red)
Weverton sandstone	Lower 2. elevation	Piedmont Plateau	Herndon gravelly loam (red)
Louden formation	Lower 2. elevation	Piedmont Plateau	Edgemont gravelly loam (yellow)
Metarhyolite		Appalachian Mountain and Plateau	Ashe stony loam
Rhyolitic breccia		Appalachian Mountain and Plateau	Ashe stony loam
Sericite schist		Appalachian Mountain and Plateau	Ashe gravelly loam
Vein quartz		Appalachian Mountain and Plateau	Ashe gravelly loam
Metarhyolite		Appalachian Mountain and Plateau	Porters gravelly loam
Edgegrove		Piedmont Plateau	Berks shale loam
Slate (unknown)		Piedmont Plateau	Berks shale loam
Schist (unknown)		Piedmont Plateau	Manor slate loam
Triassic diabase		Piedmont Plateau	Montalto gravelly loam
Triassic diabase		Piedmont Plateau	Montalto silt loam
Triassic diabase		Piedmont Plateau	Watchung silt loam (poorly drained)
Quartzite conglomerate		Piedmont Plateau	Penn gravelly loam
New Oxford		Piedmont Plateau	Penn silt loam
Upper Heidlersburg		Piedmont Plateau	Lehigh silt loam (adjacent to diabase)
Gettysburg shale		Piedmont Plateau	Lehigh silt loam (adjacent to diabase)
Conewago formation		Piedmont Plateau	Croton silt loam (poorly drained)
Lower Heidlersburg		Piedmont Plateau	Lansdale silt loam
McSherrystown		Limestone Valley and Upland	Hagerstown silt loam Yellow subsoil phase
Shenandoah limestone		Limestone Valley and Upland	Hagerstown silt loam
Bittinger limestone		Limestone Valley and Upland	Hagerstown silt loam
Limestone conglomerate		Limestone Valley and Upland	Hagerstown silt loam
Shenandoah limestone[9]		Limestone Valley and Upland	Hagerstown silt loam Colluvial phase
Limestone conglomerate		Limestone Valley and Upland	Hagerstown silt loam Colluvial phase

[7] This outline shows the general genetic relation between formations and soil types. There are some exceptions. Thus some of the metabasalt gives rise to Ashe and some areas underlain by metarhyolite were mapped as Ashe. The soil from the sedimentary Triassic rocks, the New Oxford formation, has been mapped largely as Penn, though it contains many areas of Lansdale not separated on the reconnoissance map. The soil derived from the Lower Heidlersburg formation has been mapped as Lansdale silt loam, though it contains many areas of Penn. A detailed survey would show more separations.

[8] The Tomstown dolomite is completely covered with colluvial material from the surrounding sandstone and shale formations, and consequently it was mapped as Dekalb stony loam.

[9] Surface covered with colluvial debris from adjacent slopes of soils derived from crystalline rocks.

ALLUVIAL SOILS.

River Flood Plains Province.

General character of rock from which the original material has been derived	Drainage	Position	Soil Type
Crystalline	Poor	First bottom	Wehadkee silty clay loam
Crystalline	Poor	Second bottom	Altavista silt loam
Limestone	Poor	First bottom	Holly silt loam
Limestone	Good	Second bottom	Elk silt loam
Triassic sandstone and shale	Good	Second bottom	Birdsboro silt loam
	Good	First bottom	Bermudian silt loam

It will be noted in the table above that the term "residual soils" is broadly used to designate those soils derived from underlying consolidated materials, whether of igneous, metamorphic, or sedimentary origin. The alluvial soils are those of recent stream deposition. Colluvial soil is also referred to, and here the term colluvial is used to designate soil material of a more or less heterogeneous character which has accumulated along slopes by wash and gravitational creep from adjacent slopes. When the slope accumulation consists of loose fragments of rocks, it is styled talus material and is generally mapped as rough stony land, but when the material is of fine texture it is called colluvial material by the soil scientist whether representing talus material or alluvial-fan material, or a mixture of these.

It is recognized by the soil scientist that all soils are residual when the term residual is carried to its extreme literal contruction; but it has been found convenient to consider those soils derived by decay from underlying consolidated or essentially consolidated materials as constituting residual soils. Soils derived from unconsolidated material such as those of the Atlantic and Gulf Coastal Plains are described in a general way as old sedimentary soils, although it is recognized that this usage of the term conflicts in some degree with the usage made of it by geologists. The alluvial soils are, of course, sedimentary soils; but in the parlance of the soil surveyor it has been found convenient to separate them as recent alluvium (overflowed stream bottoms) and old alluvium (second bottoms or stream terraces).

Appalachian Mountain Soils.

The soils in this province occur in the western third of the county in the South Mountain section. These have been grouped with the soils occupying high elevations on Pigeon Hill, as well as those derived from the slates and shales in the extreme southeastern part of the county. The Appalachian Mountain soils are divided into 4 series: The Dekalb, Ashe, Porters, and Berks.

The soils of the Dekalb series are light-brown to gray, with yellow friable subsoils. They owe their origin to the weathering of sandstone, shale, and quartzite. Fragments of quartzite and sandstone are scattered over the surface and disseminated through both the soil and subsoil. A gray layer is commonly present directly beneath the leaf mold of much of the higher-lying areas, and frequently, also, there is a brownish layer beneath the gray layer.

The Berks soils have brown surface soils and yellowish-brown to yellow friable subsoils. They are derived from thin, platy, argillaceous shale, varying in color from light yellow or brown to black. The bedded shale is usually close to the surface, and the soil is well drained.

The Ashe series is characterized by its brown to grayish-brown surface soils and by its yellow, well-drained friable subsoils. It owes its origin to the weathering of the underlying crystalline rocks, mostly altered rhyolite, though locally some of it is derived from rhyolitic breccia, sericite schist, vein quartz and some altered basalt. Fragments of these rocks are scattered over the surface and distributed through the vertical section. The topography is rolling to hilly.

The soils of the Porters series are characterized by brown surface soils and by red, friable subsoils. They are deep, well-drained soils that owe their origin to the weathering of the underlying crystalline rocks, which in Adams County consists largely of altered besalt.

Piedmont Plateau Soils.

The soils in this province occupy about two thirds of the county. With few exceptions, they cover all of the extent of residual soils east of the South Mountain foothills. They owe their origin to the weathering of the underlying formations, which consist of (1) Triassic sandstone, shale, conglomerate, and diabase, and (2) of Pre-Cambrian crystalline rocks. The resulting soils are grouped in nine series: The Penn, Lansdale, Croton, Lehigh, Montalto. Watchung, Manor, Edgemont, and Herndon.

The Penn series includes the Indian-red or chocolate-red soils derived from the Indian-red or chocolate-red shales, conglomerates, and sandstones of Triassic age. They are a little more brownish in the surface section than in the subsoil. The subsoil color is essentially identical with that of the parent rock. In structure the subsoil is friable to moderately stiff or brittle.

The Lansdale soils are characterized by brown or grayish-brown surface soils and by yellow friable subsoils. They owe their origin to the weathering of the brownish or yellowish underlying Triassic shales, conglomerates, and sandstones. The subsoils are a little more friable than those of the Penn.

The Croton soils are characteristic by grayish-brown to brownish-gray or ashy-gray soils, and by yellowish or mottled yellowish and grayish plastic, impervious subsoils. The lower subsoil is often very compact, having the character of a hardpan in places, in most places in fact, especially where dark-colored concretionary material was accumulated. This hardpan or claypan is mottled bluish and purple or salmon colored. These soils are derived from Triassic sedimentary rocks, but they have had their distinguishing characteristics impressed upon them through weathering under poorly drained conditions, as distinguished from the good drainage under which both the Penn and the Lansdale soils have been formed. The dry soil is essentially white at the surface, or at least very gray. The accident of position, the flat surface and resultant slow run-off of rainwater, probably accounts for the development of the hardpan or claypan. The process by which such hardpan and claypans are formed is not clearly understood in every detail, at least not with certainty. It is known that claypans and hardpans of this order are found on flat areas where the surface drainage is imperfect, and it is believed that percolating water frequently carries some of the fine particles from higher to lower lands and also carries certain soluble constituents to lower levels, where conditions favor precipitation and concentration of the materials carried in solution. Perhaps at this level there develops, when the downward movement of moisture is arrested by the water table or by an impervious accumulation of clay, a point of concentration in the checked water, which, with the right temperature and atmospheric and hydrostatic pressure, causes precipitation of such components as iron salts; and it is possible this precipitated material tends to seal up the pores of the clay, or whatever material the precipitation takes place in, to form a highly impervious layer—a claypan or a true hardpan.

The Lehigh soils are characterized by the bluish-gray to dull chocolate-gray or purplish-gray color of the surface soils and the chocolate-gray or mottled gray and yellow color and frequent compact structure of the subsoil. The parent rock consists of Triassic shale and sandstone which have been partly metamorphosed by heat and pressure from the intrusive dikes of trap rock. The parent rocks have a leaden-grayish to purplish-gray color, much like the color of the derivative soil.

The soils of the Montalto series are light brown in the surface section and reddish-yellow in the subsoil section. They are derived from the weathering of the underlying diabase and occur in strips along the rather narrow dikes which usually protrude above the surrounding Penn and Lansdale soils.

The Watchung soils are characterized by their gray surface soils and mottled gray or bluish gray and yellowish, plastic, heavy clay

subsoils. They are derived from diabase, but unlike the Montalto soils from the same parent rock, they have been formed under conditions of poor drainage, as a result of occurrence in low flats and depressions without adequate drainage outlets. Often the lower subsoil is compact like claypan or hardpan. The plowed soil when dry is white, or nearly so.

The manor soils have brown soils and reddish-yellow or yellowish-red, moderately friable to brittle subsoils. They are derived from grayish-green (dovecolored) or green, finely laminated chloritic schist. The fine schist particles in the partly weathered stage give an extremely greasy feel to both the surface and subsoil material.

The Edgemont and Herndon soils are derived from the quartzite formations of the Pigeon Hill section of the county. They are deep, gritty, gravelly soils which differ from each other largely in the color of subsoils. The Edgemont is characterized by light brown surface soils and a yellow, moderately friable to brittle subsoil, while the Herndon series has about the same kind of soil but a red or dull reddish-brown, brittle to moderately friable subsoil.

Soils of Limestone Valleys.

The soils of the limestone valley province have been derived from limestone, and represent material left upon the removal in solution of the calcium and magnesium carbonate contained in the parent rock. The soil is thus composed of the impurities that were present in the original rock. The Hagerstown silt loam is the only soil of residual limestone origin mapped in the county.

The Hagerstown soils are typically brown with reddish-yellow or reddish-brown, moderately friable subsoils. They are well drained, occupy gently rolling country, and are very productive.

Soils of the River Flood Province.

The river flood plains province includes areas of soils that have been transported and deposited by the rivers and streams. These are divided with two classes, depending upon their position with respect to overflow. Those types occupying stream flood plains subject to periodic overflow and still in process of formation and change are designated first-bottom soils. The repeatedly added sediments over these bottoms tend to check normal soil development in one respect at least, that is, in the development of well-defined layers through the vertical section, such as are present in older soils where there has been opportunity for more or less transposition of the finer particles from higher to lower levels, and for leaching of the upper layers. The second-bottom or terrace soils occupy stream benches which formerly were subject to flooding, but which are no longer overflowed, except in case of some of the lowest benches in

time of very high water. This change has been brought about by the cutting down of the stream channel, and readjustment of the bottoms to fit the lowered position of the channel. The first-bottom soils mapped in the area have been grouped in the Bermudian, Wehadkee, and Holly series, and the second-bottom soils in the Altavista, Birdsboro, and Elk series.

The Bermudian series includes soils which are brown or reddish-brown or chocolate-reddish-brown in the surface section and chocolate-red or Indian-red in the subsoil, with some yellowish mottling in the lower subsoil of many areas. These soils are derived from alluvial material which has been washed partly or entirely from the Penn and Lansdale soils of the uplands. Their chocolate-reddish color is due to color of the included Penn soil material.

The Wehadkee soils have gray to brownish-gray surface soils and bluish, or mottled yellow and gray or bluish-gray, plastic, heavy subsoils. They are composed of alluvial materials washed from the Montalto, Manor, Porters, and Ashe upland soils. On drying the plowed surface has a whitish color. Dark colored or rusty-brown concretions are present in places, especially in the subsoil.

The Holly soils are distinguished by their gray surface color and by the mottled yellow and gray or bluish-gray color of the subsoil. They occur in the first bottoms of streams receiving wash from the Hagerstown upland soils, together with, as a rule, some wash from sandstone and shale soils. They are poorly drained soils even between periods of overflow. A compact lower subsoil or substratum, an underlying impervious clay layer impedes downward movement of moisture, thus effecting poor drainage. Plowed fields when dry are nearly white.

The Wehadkee and Holly soils have very similar physical characteristics—essentially the same color in both soil and subsoil sections, and the same order of structure in both the soil and subsoil. They react in about the same way to internal moisture movement. Having about the same crop value, it is not improbable the chemical constitution is much the same, but not enough chemical analyses have been made to verify this. These two soils, as well as other similarly colored soils of the stream bottoms of the humid region, have not been studied sufficiently to say finally that there are no important fundamental differences between them. It is known that they contain material washed entirely or in part from upland soils of markedly dissimilar characteristics. It must be confessed that the impress of poor drainage (meaning poor underdrainage) has had a decidedly leveling effect upon the visible characteristics of many varying kinds of original alluvium, making that, for example, derived from soil formed from limestone very closely resemble that derived from soils formed from sandstone and shale, even that derived from the red shales.

There is much greater dissimilarity in the visible characteristics of the well-drained alluvium derived from varying upland soils, especially between that washed from the red soils, as the red Penn soils, to form the Bermudian soils and that washed from the brown, gray and yellow soils, as the Dekalb, to form the Pope soils (not mapped in Adams County). The presence of but a small proportion of the peculiar chocolate-red material washed from the Penn soils is sufficient to give well-drained alluvial soil a decidedly chocolate reddish color utterly unlike any other alluvial soils of the Piedmont stream bottoms. Under wet, soggy conditions, however, this red color can quickly be completely obliterated and give way to a light gray, bluish-gray, or mottled soil.

Some of the well-drained alluvial soils of different origin, however, do resemble each other in their visible characteristics. The Pope soils, composed of alluvium washed entirely or very largely from noncalcareous shale and sandstone soils, are much like the Huntington soils, that is, alluvial soils whose component material has been washed largely or wholly from limestone soils. The soils of both the Pope and Huntington are brown, while their subsoils are yellow or light brown and friable in structure, the Pope averaging possibly a little lighter in color. Regardless of the essential physical duplication, there are fundamental differences in these soils, as evidenced by the fact that invariably the Huntington soils are inherently more productive than the Pope soils, giving much better yields of corn and other crops, from the same types receiving the same kind of treatment.

The origin of the material, therefore, is a very important factor in the classification of alluvial soils, and it is not considered safe to ignore it even in case of the light-colored, poorly-drained alluvial soils, which frequently are essentially the same in their visible properties, although differing in origin.

The Altavista soils characteristically have gray to dark grayish surface soils and gray or bluish gray, and yellow, heavy, plastic, impervious subsoils. They occupy second-bottom positions and represent old alluvium derived in part or largely from soils formed from crystalline rocks. The drainage is poor to imperfect. The plowed surface is very light colored when dry.

The Birdsboro soils are the second-bottom correlatives of the Bermudian soils. They are composed of old alluvium derived in part or largely from the Penn soils. They have soils of a brown to chocolate-brown color and subsoils of chocolate-red or Indian-red color. The drainage is well established.

The Elk soils are brown in the surface section and yellow and moderately friable in the subsoil. They are second-bottom old alluvial soils, the material of which has been washed largely from the Hagerstown soils.

Physical Changes in Soil.

Although the principal types of rocks have given rise to definite soils, save those which have been altered by poor drainage, and thus have determined the distribution of the soils of the area, as already pointed out, it should not be assumed that changes have not taken place in the material between the rock and soil stages. Of course there has been a profound physical change—a change from consolidated rock to unconsolidated soil-forming material. Aside from this there have been obviously profound changes in some instances, and in others but slight apparent changes. The chocolate-red shales have broken down to form, in situations of good drainage, Penn silt loam having essentially the same color as the rock, so much so that the exact place of change from the subsoil clay to soft disintegrated but not completely decomposed rock is difficult to determine. It is not believed that there has been any very great chemical change in this case from rock to soil, except of course the presence of accumulated organic matter and nitrogen in the soil as a result of plant and bacterial life.

In the case of the change from limestone soil the great mass of calcium carbonate or magnesium carbonate in the original rock has gone into solution and been carried away, so that probably many feet of rock have been required to form a single foot of soil, the soil representing the impurities in the original rock, so to speak. No free lime carbonate can be detected with acid at any depth in the limestone soil, except where a piece of limestone has been preserved or lime concretions may have been formed in the deep substratum (the material below 3 feet). Thus limestone has been converted into soil containing only a small amount of lime, and that largely in some form other than the carbonate. Lime is liberally used on the limestone soils of Pennsylvania as a means of soil improvement.

This residual limestone material—the limestone soils—gives a very productive soil—the most productive upland soils in the State. Lime stone soils without exception, seemingly, are exceptionally productive throughout the humid region, wherever the drainage is good. Little or no lime carbonate is present in the Montalto soils (derived chiefly from diabase) within the soil, subsoil, or substratum. In some respects, as color, the Montalto silt loam resembles the Hagerstown silt loam, having, however, a stiffer clay subsoil; yet the Hagerstown is a considerably more productive soil. The impress of the parent limestone rock upon the derivative soil is strongly existent in its high productivity, even should this not be revealed by chemical analysis.

Aside from the material dissolved and carried away in the course of rock disintegration and the decomposition of the disintegrated material, with the final evolution of soil, there is no strong evidence of excessive leaching in the soils. In some flat areas of poor drainage

there seems to have been some concentration of iron salts at lower depths, but these areas are of small importance. Had there existed here excessive flat areas with a gradient too slight for rapid run-off of rainwater, the effects of leaching possibly would have been more in evidence. As it is, most of the land has enough slope for the rainwater to flow off quickly—fast enough, except on the porous gravelly areas, to accomplish some erosion. Loss by erosion, mostly slow sheet erosion, probably is much greater than loss by leaching or by leaching and crop removal combined. Unquestionably, as the result of the plowing down of sod, crop residues, and manure, many fields contain more vegetable matter or humus than the virgin soil contained. This, of course, refers to well managed fields where farmers have practiced crop rotations and other good farm methods. The deep brown color of the soil as compared with a lighter brown or yellowish color in timbered areas of the same soil indicates the greater content of humus.

Relation Between Geological and Soil Maps.

There is a close relationship between the geological map and the soil map of Adams County. Such close relationship may be expected wherever the lithologic nature of the rocks has been mapped, especially in the humid region, where the drainage is prevailingly good and erosion is prevailingly active. Where the geological map is based upon age of the rocks in such a way that lithologic differences are not distinctly emphasized there may be little resemblance between the soil map and the geological map.

DESCRIPTION OF ADAMS COUNTY SOILS.

In the following pages the various soils of Adams County are described in detail and their relation to agriculture is discussed. The distribution of the soils is shown on the accompanying map, and the following table gives the name and the actual and relative extent of each type:

Areas of different soils.

Soil	Acres	Per cent	Soil	Acres	Per cent
Penn silt loam	92,544	27.4	Wehadkee silty clay loam	5,120	1.5
Montalto silt loam	34,304	10.1	Berks shale loam	4,672	1.4
Lehigh silt loam	32,320	9.6	Manor slate loam	4,288	1.3
Ashe gravelly loam	28,224	8.3	Porters stony loam	2,368	0.7
Dekalb stony loam	27,712	8.2	Croton silt loam	2,304	0.7
Porters gravelly loam	20,608	6.1	Montalto gravelly clay loam	1,664	0.5
Lansdale silt loam	17,472	5.2	Holly silt loam	1,472	0.4
Hagerstown silt loam	4,032		Herndon gravelly loam	1,344	0.4
Yellow subsoil phase	9,408	4.7	Elk silt loam	1,024	0.3
Colluvial phase	2,368		Watchung silt loam	384	0.1
Penn gravelly loam	13,696	4.0	Altavista silt loam	192	0.1
Bermudian silt loam	13,440	4.0			
Ashe stony loam	11,136	3.3			
Birdsboro silt loam	5,824	1.7	Total,	337,920	

Penn Silt Loam.

The Penn silt loam consists of an Indian reddish-brown or chocolate reddish-brown to Indian-red or chocolate-red silt loam, underlain at about 8 to 12 inches by Indian-red or chocolate-red silty clay loam, which is usually of a friable nature. In place, the subsoil is somewhat compact, but loosened fragments of it crush readily between the fingers. Frequently chocolate-red, brittle clay is encountered at depths of about 20 inches. The Indian red or chocolate-red parent shale is usually reached less than 3 feet below the surface. Small shale fragments are present throughout the soil section. The color of the subsoil is essentially identical with the color of the parent rock. Included with the Penn silt loam, as mapped, are some areas of Penn shale loam, Penn loam, and Lansdale silt loam.

The Penn silt loam is the most extensive soil in Adams County, comprising as roughly mapped by the reconnaissance survey, together with some included Lansdale soils and Penn loam and shale loam, 92,544 acres or approximately 27 per cent of the area. It occurs east of the foothills of South Mountain, in large, almost uninterrupted tracts in the vicinity of New Oxford and Germantown, west of Littlestown, northeast of Gettysburg and elsewhere in the eastern half of the county. The topography is gently rolling to nearly flat, and the natural drainage is good. The subsoil retains moisture well, so that crops do not suffer from drought so much as on the shale loam.

The type is nearly all cleared, the remaining wooded areas for the most part consisting of five or ten acre tracts used for woodlots. The principal trees are red oak, white oak, chestnut oak, and other oaks, dogwood, hickory, maple, ash, and elm. The most important crops grown are corn, oats, wheat, hay (timothy and red clover), rye, and Irish potatoes. Dairying is very important on this type, especially in the vicinity of Littlestown. Many of the farmers on this soil feed their roughage and corn to beef cattle during the winter. Raising poultry in conjunction with crops is an important industry. There are a few large poultry farms, but the average farm has about 150 hens. The predominating breed is White Leghorn. Hogs are raised in sufficient quantity to supply home needs for pork.

The Penn silt loam is not considered to be so well suited to the production of apples as are the Porters gravelly loam, Ashe gravelly loam, Penn gravelly loam, and Montalto silt loam types. This probably is due to the relatively low-lying position much of the type occupies, as well as to the rather shallow soil depth. The few large commercial orchards on it are upon the higher, more rolling situations. The yields of the principal crops are fairly good. Wheat yields on the average about 18 bushels per acre, corn about 35 to 55 bushels; oats

averages about 25 bushels; and hay ranges in yield between 1 and 2 tons. Much larger yields than these are obtained by the better farmers.

Crop rotations are practiced by nearly all farmers. The most common rotation is corn followed by oats, oats by wheat, and wheat by clover-timothy sod. Timothy is seeded with the wheat and red clover is broadcasted in the wheat the following spring. The hay is cut for one or two years. The present system of fertilizing could be improved. Where manure is plowed under for corn, acid phosphate or bone fertilizer applied at the rate of about 250 to 400 pounds per acre, either with the manure or at time of planting the corn, has considerably enhanced the yield. Oats should be fertilized in most cases with about 200 to 250 pounds of acid phosphate. The wheat crop should receive any manure remaining after the corn has been treated. A good way to apply manure to wheat is to broadcast with a manure spreader on the young grain late in the fall or early in winter. When wheat receives manure, an application of about 350 pounds of acid phosphate is sufficient. This can be applied in the drill at seeding time. Where no manure is used on the wheat an application of about 350 to 400 pounds of a 2-12-2 fertilizer will be found effective.

It seems better to plow down sod after the first year's cutting. Where hay is needed and the grass is cut for 2 years, it usually pays to apply 100 to 150 pounds of nitrate of soda or sulphate of ammonia as a top dressing to the sod early in the spring of the second year. It is believed sweet clover could be made a soil-improving crop of importance on this type.

Lime should be applied in fair amounts once about every 4 to 6 years. A good plan is to broadcast it on the plowed ground before drilling in wheat.

The Penn silt loam as a whole is good general-farm soil. Good methods of soil management are being practiced. Most of the farms have good buildings and are located only a short distance from good roads. The present value of the land ranges from about $75 to $200 an acre, depending upon location, state of productivity, and improvements.

The following table shows a complete chemical analysis of the soil and subsoil of the Penn silt loam, collected from a virgin timbered (oaks, hickory, elm, and dogwood) area one-half mile southwest of Barlow. The analyses were made in the laboratory of the Bureau of Soils, U. S. Department of Agriculture.

Chemical composition of silt loams in Adams County.

[G. H. Hough, analyst.]

Constituents	Penn Silt		Lansdale		Lehigh	
	Soil	Subsoil	Soil	Subsoil	Soil	Subsoil
	No. 29,462 0 to 10 inches	No. 29,463 10 to 20 inches	No. 29,464 0 to 14 inches	No. 29,465 14 plus inches	No. 29,466 0 to 12 inches	No. 29,467 12 plus inches
SiO_2	70.73	67.65	73.30	69.55	67.74	62.61
TiO_2	0.95	0.89	0.95	0.95	0.95	0.95
Fe_2O_3	4.62	5.57	3.67	4.63	6.36	7.94
Al_2O_3	13.88	15.80	13.32	15.44	13.90	17.18
MnO	0.08	0.04	0.04	0.02	0.18	0.05
CaO	0.50	0.50	0.40	0.40	0.55	0.40
MgO	1.62	1.74	0.93	0.93	1.46	2.15
K_2O	1.74	2.24	2.57	2.68	2.39	2.98
Na_2O	0.91	0.77	1.29	1.93	0.99	1.15
P_2O_5	0.07	0.03	0.05	0.17	0.08	0.07
SO_3	0.08	0.04	0.02	0.07	0.12	0.06
Ignition loss	5.67	4.29	4.87	3.66	5.37	4.76
Total	100.90	99.56	101.41	100.43	99.99	100.30
N	0.10	0.04	0.08	0.03	0.09	0.04
CO_2 from carbonates	none	none	none	none	none	none
Organic matter						
H_2O at 110°	1.30	1.25	1.40	1.60	1.30	1.30

Penn Loam.

The Penn loam type has been included with the silt loam on the soil map. It differs from the silt loam in having a loam instead of a silt loam soil and a subsoil which is somewhat lighter in texture. It is, perhaps, not quite so strong a soil as the silt loam, but it is easier to work and responds readily to good treatment. The largest areas recognized were seen northeast and southeast of New Oxford, where the soil overlies the New Oxford sandstone and shale formation of Triassic age. Fine-grained sandstone seems to have been more prominent in the formation of the Penn loam than of the Penn silt loam, the latter having been derived more largely from shale and shaly sandstone.

Penn Shale Loam.

The Penn shale loam occurs on the steeper portions of the slopes where erosion is more rapid and the soil shallower. This type differs from the Penn loam in that it contains a large quantity of shale fragments, which tend to make the soil very porous. Bedded shale is usually packed with 18 or 20 inches of the surface or at shallower depths. The upper layers of the shale are so cracked that the loam has excessive underdrainage. Maximum yields are made in years of abundant well distributed rainfall. This moisture-holding capacity and general productivity can be improved by growing and occasionally plowing under a legume crop, as clover, or some other crop, as rye. The steeper slopes should be used for farm woodlots, permanent pastures, or orchards.

On the soil map this type has been included with the Penn silt loam.

Penn Gravelly Loam.

The typical Penn gravelly loam consists of chocolate-red or Indian-red to Indian reddish-brown or chocolate reddish-brown gravelly loam, passing beneath into deep Indian-red or chocolate-red gravelly loam or gravelly clay loam subsoil. This soil is derived from a conglomerate consisting of rounded and sub-angular pieces of quartz and quartzite embedded in a matrix of Indian-red or chocolate-red consolidated clayey material. The red cementing material or matrix forms the major portion of the fine soil material, but the gravel is unaltered. The gravel adds to the porosity of the soil, so enhancing its absorptive capacity for rainwater as to give marked stability against erosion. Notwithstanding the porosity, enough fine material is present to make this soil fairly retentive of moisture.

The type occurs along the northwestern border of the Triassic sedimentary rocks. The largest areas are those in the north-central part of the county southwest of Arendtsville north of Biglersville, north of Bendersville Station, and west of York Springs. The soil occurs on ridges and hills which stand about 200 to 300 feet above the Lansdale soils and other Penn soils.

Large tracts of Penn gravelly loam are covered with second and third growths of oak and hickory. The original forest included much chestnut, but this has been killed by the chestnut blight. The deep friable character of the soil and its ability to hold moisture, together with its favorable position, adapt it ideally to apples and peaches. Many large, thriving orchards of both these fruits are on this type of soil. The area as mapped in the county amounts to 13,696 acres.

General farming is practiced to some extent on the gravelly loam, and the yields are about the same as those obtained from the Penn silt loam. The abundance of gravel probably has discouraged agricultural utilization to some extent.

Lansdale Silt Loam.

The Lansdale silt loam consist of a brown to chocolate-brown silt loam overlying yellow, yellowish-brown, or light chocolate-brown silty clay loam to friable silty clay. In places the lower subsoil is faintly mottled with gray. The color of the soil, that of the subsoil section particularly, is approximately like that of the parent rock. Fragments of brownish sandstone and shale of the parent rock are usually found on the surface and throughout the soil section. The more important areas where these are abundant enough to have any material influence upon cultivation have been shown on the map by gravel symbols. The subsoil has a friable structure favorable to the

retention of moisture and the movement of this moisture to meet the requirements of crops. Usually the subsoil is not quite so stiff as that of the Penn silt loam.

The areas mapped as Lansdale silt loam include numerous small bodies of Penn silt loam that would have been mapped separately in a detailed survey.

The Lansdale silt loam occurs in large, more or less continuous areas from York Springs to the foot of the ridge about 2 miles east of Fairfield. The surface is gently rolling, with an occasional ridge or hill. The soil is naturally well drained. According to the reconnaissance mapping there are 17,472 acres in the county.

The Lansdale silt loam is an important soil agriculturally. Wheat, timothy, clover, and corn are the main crops. Oats and rye are grown to a limited extent. The type is very largely under cultivation. The uncultivated areas are covered for the most part with chestnut oak, red oak, chestnut, hickory, black locust, dogwood, and ash.

In addition to the growing of general-farm crops, many farmers have dairies and many feed beef cattle during the winter months. Hogs and poultry are raised in sufficient quantity for the home supply. Alfalfa does well on this type of soil. Alfalfa, red clover, or sweet clover should be included in the rotations, because of the effectiveness of these crops as soil improvers.

Crops are grown in regular rotations, and, in general, the type is handled in much the same manner as the Penn silt loam. The crop adaptation and yields are quite similar for the two soils. Some farmers, however, prefer the Penn silt loam to the Lansdale, claiming that yields on the former are somewhat heavier.

The table on page 25 shows a complete chemical analysis of the soil and subsoil of the Lansdale silt loam collected from a virgin timber area one mile northwest of McCleary School.

Lehigh Silt Loam.

The surface soil of the Lehigh silt loam is an ashy or light purplish-gray to grayish-brown or chocolate-gray silt loam, underlain at depths of about 6 to 8 inches by pale or purple bluish-gray or leaden-gray silty clay loam to clay. The subsoil in many places is compact, and in dry weather it probably interferes with the upward capillary movement of moisture, so that crops may not have as favorable supply at critical stages as they would have on the Lansdale and Penn silt loams. Usually the subsoil is somewhat mottled with yellow and brown, owing largely to the presence of disintegrated shale fragments. Bedded shale or sandstone is usually encountered at depths ranging from 18 to 36 inches. Over the bedrock there is a layer of grayish, partly disintegrated and decomposed rock particles. Fragments of a dull grayish and purplish shale are

present in many places. The larger areas where these fragments occur in large quantity have been indicated on the map by symbols. The principal gravelly areas occur east of Fairfield. The soil has much the same color as the parent rock, especially the subsoil section.

The Lehigh silt loam lies adjacent to the soils derived from the outcrops of trap rock, and owes its origin to the weathering of sandstone and shale which has been partly metamorphosed by contact with the trap-rock magma. The type occurs in long, rather narrow strips through the central part of the county, usually occupying the slopes between the areas of the higher Montalto soils and the lower lying Penn and Lansdale soils. This soil is fairly well drained, although in many places the subsoil indicates imperfect circulation of water through the body of the soil. In areal extent this type is third largest in the county, covering 32,320 acres, including the minor types not separated.

Nearly all of the type has been cleared of its native growth of oaks, chestnut, and pine, and is being cultivated. Locally it is called "blue land," and it is not a popular soil, being considered a type upon which crops suffer more from the vicissitudes of climate than on soils like the Penn and Lansdale silt loams. It is being farmed in about the same manner as the Penn and Lansdale soils, but does not give as good results. Where the slope provides proper air drainage, and where the soil drainage is good, apple orchards seem to do well on this soil. Lime is needed, and clover or other legumes should be included in the rotations. Sweet clover probably could be grown to advantage as a soil improver.

The table on page 25 gives the results of a chemical analysis of the soil and subsoil of the Lehigh silt loam, made in the laboratory of the Bureau of Soils. The sample was taken from a timbered area in the south-central part of the county one and one-half miles west of Barlow on the side of a ridge about 200 feet from a narrow dike.

Croton Silt Loam.

The Croton silt loam consists of a grayish-brown to ashy-gray silt loam about 5 to 8 inches deep, overlying pale-yellow or mottled yellow and gray or bluish-gray silty clay loam, which quickly passes beneath into stiff, plastic clay, mottled bluish-gray and yellow. A claypan is encountered at depths ranging from about 20 to 35 inches, which consists of mottled bluish and pale pink or salmon-colored, very tough clay of a highly impervious nature. Occasionally this tough layer is mottled bluish-gray and yellow. In places a slightly better drained phase has been included with this soil as mapped. This phase differs in having a pale-yellow or pale-red upper subsoil, with the characteristic mottled lower subsoil. In such areas the hard claypan lies at lower depths than in the typical soil.

Included with the type, as mapped 2 miles northeast of New Oxford, are small areas of Penn loam, Penn silt loam, and Lansdale loam, which were considered too small to attempt to separate on a reconnoissance map. Only 2,304 acres were mapped, with all inclusions.

The Croton silt loam occurs in the eastern half of the county in small areas on flats and in slight depressions about the heads of streams. It is a poorly-drained soil both on account of inadequate surface relief and the impervious nature of the claypan. The flat surface and slow runoff of rainfall probably account for this development of the claypan.

The type is largely undeveloped. It is used chiefly for pastures. It is not very extensive, and hence not very important. Where cleared and drained it produces fair crops of hay, rye, oats, and similar shallow-rooted crops.

In addition to improvement by drainage, benefits undoubtedly would accrne from rather liberal treatment with lime. Herdsgrass or redtop and alsike clover might find a satisfactory abode on this type, especially after ditching. It is possible that open ditches would effect satisfactory drainage. If tile is laid, it might be well not to bury it in the claypan or hardpan because this is so impervious that drainage would be slow in getting through to the tiles. Tile drains have been reported as being essentially inoperative, except to a distance of a few feet from the tiles, in soils where the drain was placed well down in a highly impervious clay subsoil.

Montalto Silt Loam.

The soil of the Montalto silt loam consists of a light-brown or brown silt loam, which often has a reddish cast, especially when moist. The subsurface layer beginning at depths of about 8 to 10 inches is a reddish-yellow, friable clay loam. This quickly passes into the subsoil of reddish-yellow or dull-red, somewhat brittle clay often containing enough micaceous material to impart a greasy feel. Usually the soil is noticeably gritty, the grit consisting of particles of incompletely decomposed rock. In places the soil contains enough grit to form a gritty loam and in other places the surface has been washed off, exposing patches of clay loam, which are referred to in some localities as "gall spots," "clay spots," and "washed land." Included with the type, as it has been mapped, are areas containing large quantities of angular stone fragments and here and there a huge boulder. Some areas, as those just south of Gettysburg (on Little Round Top and Big Round Top), contain so many large stones that the land would be classed in a detailed survey either as stony loam or as rough stony land. These stones are locally known as "ironstone," and the soil as "ironstone land."

The Montalto silt loam occurs in narrow strips or belts here and there throughout the eastern half of Adams County. These strips vary in width from a few feet to three or four miles. The largest continuous body extends in a southwest direction across the county, passing through Amatus, Newchester, Granite Hill, and just south of Gettysburg. Another important area joins this larger one near the Maryland line, and extends northward to Orrtanna. This soil occurs on hills or ridges which rise in places many feet above the surrounding shale lands. The areas usually stand out conspicuously above the Penn, Lansdale, and Lehigh soils as ridges or as a series of hills. in extent this type stands second, with an area of 34,304 acres, inclusive of the minor variations and types not separated on the soil map.

The Montalto silt loam is a well-drained productive soil. The more stony and steeper areas, the less arable part, are covered with chestnut oak, witch-hazel, basswood, and maple. Many large thrifty commercial apple and peach orchards are on this soil. The principal crops are corn, oats, wheat, hay, rye, and potatoes. Many of the farms have a surplus of dairy and poultry products for sale. The rougher areas are used by many farmers for pastures. They should be used for this purpose or else for farm woodlots, as the clearing away of the stone would be too expensive and the steep slopes under cultivation would suffer from erosion. The soil is fairly well handled where farmed, crops are grown in rotations, the tillage is usually efficient, and the farm equipment usually is satisfactory. Fertilizer is used on corn, wheat and potatoes. This soil has been used in other localities for the production of late vegetables, such as tomatoes, and for peaches, apples, and cherries. It is easily converted, in the case of run-down fields not badly eroded, into a productive soil by the proper use of lime, manure, and fertilizer, and by the inclusion of clover or other legume in the rotations. No doubt many more areas will be used for the production of apples in the near future.

Sweet clover probably can be grown to good advantage as a soil improver.

Montalto Gravelly Clay Loam.

The Montalto gravelly clay loam is a reddish-brown to brownish-red gravelly clay loam, passing at about 8 to 10 inches into red, brownish-red, or yellowish-red friable clay. The friable nature of the lower subsoil seems to be due, in part at least, to the large amount of partly decomposed rock fragments present. The gravel consists of fragments of dark-colored igneous rock resembling trap rock.

The type occupies hills and ridges, occurring here and there through the north-central part of the county. It is of limited extent, and therefore of no great importance in the agriculture of the county.

The largest and most important areas are near Arendtsville and Latimore. It is naturally a well drained soil. Only 1,664 acres were mapped.

The Montalto gravelly clay loam is a productive soil. It resembles the Montalto silt loam in many ways, differing from it in being somewhat harder to handle owing to its more gravelly and heavier nature. It responds well to good treatment, and is harder to impoverish than the silt loam, probably because the gravel imparts a porosity that impedes erosion. Excellent stand of clover was seen on it as well as many good looking apple orchards. Sweet clover probably would succeed.

Watchung Silt Loam.

The surface soil of the Watchung silt loam is a light-gray to grayish-brown heavy silt loam. This passes quickly into a subsurface of mottled gray and rusty-brown silty clay loam, which, in turn, in most places soon grades beneath into bluish, plastic, heavy clay, which often shows yellow mottling. In places below depths of about 20 inches some crystalline rock fragments are encountered.

The type occurs in depressions about the heads of streams in the region of the Montalto soils. It is Montalto material altered by poor drainage. Owing to its limited extent, 384 acres, and extremely poor drainage it is of little importance. Some small areas have not been shown. Nearly all of the areas have been cleared and are used for pasture. Some of the wettest areas can be pastured only during the very driest time of the year, because of the boggy condition. Many of the smaller bodies are being cultivated, but crops do not grow well.

This soil is much in need of drainage, but owing to the extremely heavy nature of the lower subsoil care must be taken in placing the drains, as they might prove more or less ineffective if placed too deeply in the impervious clay. Open ditches may be found as effective or even more so than tile drains. The soil is also in need of lime.

The type is quite similar in its most conspicuous characteristics to the Croton silt loam. Its adaptabilities, capabilities, and needs are much the same as those of the Croton.

Manor Slate Loam.

The Manor slate loam is a brown, mellow silt loam, grading at about 10 inches into light reddish silty clay loam. This passes into red clay having a greasy feel. Flat, platy fragments of the parent greenish schist rock are abundant in the soil and subsoil. For this reason the land is locally known as "slate land." In most places the lower subsoil is a mass of partly decomposed rock fragments. On the slopes the subsoil, as far as seen, is brown or yellowish clay loam. The red clay subsoil probably is covered in such places by rock debris from above.

The Manor slate loam, with an area of about 4,288 acres, is confined to the rolling, smoothly rounded slopes and hillocky section in the extreme southeastern part of the county. It is well drained. The drainage is excessive where the schist rock comes near the surface and where the soil consists chiefly of schist fragments.

The type for the most part is cleared and is under cultivation. With proper management, it produces large yields of corn, oats, wheat, and hay. In addition, this soil is used extensively for growing sweet corn and peas, and some other truck crops. The canning factory at Littlestown depends almost entirely upon this soil for corn and peas.

The Manor slate loam needs a good supply of organic matter or humus in order to be sufficiently retentive of moisture for the best crop yields. Frequently the structure is too loose and open, and the loam needs absorptive material, such as can be supplied to some extent by plowing in vegetation and manure. The successful farmers plow down frequently a good sod of clover, and many use considerable quantities of manure as well as fertilizer. In Lancaster and Chester counties many farmers are making a success with potatoes, apples, and peaches on this soil.

Herndon Gravelly Loam.

The Herndon gravelly loam is a brown to yellowish-brown gravelly loam, grading into a yellowish-brown gravelly clay loam, and this into red gravelly clay of a friable nature. The gravel consists of angular quartzite. The thickness of the soil section (including surface soil, subsurface, upper subsoil, lower subsoil and substratum) is from about 4 to 8 feet. The abundance of gravel prevents severe erosion even on steep hillsides.

The type is of limited extent, being found only in the vicinity of Pigeon Hill, where it occurs as steeply sloping land. It is well drained. The area shown on the map measures 1,344 acres.

Only part of the Herndon gravelly loam is cleared. This makes a very good soil for the production of the general farm crops, particularly where liberally supplied with manure or vegetable matter plowed down. Peaches and apples do well where they have been handled properly. The chief drawback to this soil is the difficulty in cultivating owing to the high gravel content and the steep topography. The rougher areas should be kept in timber or permanent pastures. The principal trees are oak, chestnut and pine. Rotations should include the soil improving legumes, as red clover.

Edgemont Gravelly Loam.

The surface soil of the Edgemont gravelly loam ranges from a gray to grayish-brown silt loam to gritty loam about 8 to 12 inches deep.

This overlies yellow friable silty clay loam. In places along the lower slopes the subsoil below depths of about 3 feet is a yellowish-red clay. Such areas would be classed as a colluvial phase of Herndon gravelly loam in a detailed soil survey. The gravel consists of angular fragments of quartzite.

The Edgemont gravelly loam and the Herndon gravelly loam are similar in nearly all respects except in the color of the subsoil, the latter being red and the former yellow. Both occupy country of steep, rough topography in the Pigeon Hills. The Herndon is considered by most farmers to be somewhat stronger soil than the Edgemont.

Like the Herndon, the Edgemont is an excellent soil for growing, being especially suited to peaches. Clover or other crops supplying organic matter should be grown in order to keep up a favorable supply of humus. Commercial fertilizer and manure will increase the yields.

Hagerstown Silt Loam.

The typical Hagerstown silt loam is characterized by a brown to reddish-brown silt loam surface soil extending to a depth of 10 to 12 inches, where it is underlain by friable, yellow or reddish-yellow silt loam to silty clay loam, passing quickly beneath into red friable clay. In places the surface soil has been washed away, exposing the underlying red, heavier material. Chert and limestone fragments are present throughout the 3-foot section. In a few places the underlying limestone is encountered within 3 feet of the surface, and it outcrops here and there. The area of Hagerstown silt loam mapped northeast of Virginia Mills is more nearly flat than the other areas, and includes some imperfectly drained tracts, as well as some alluvial soil.

This type has been mapped north and west of Fairfield and Cashtown, where it occupies gently rolling country. It is a naturally well-drained, productive soil. With the inclusions 15,808 acres have been shown on the reconnaissance map.

Probably no soil in the State is better for the production of corn, wheat, and hay. It is also well suited to alfalfa. Dairying and the feeding of beef cattle are important industries. Crops are grown in regular rotations and the cropping and fertilizer treatment is similar to that practiced on the Penn silt loam.

The Pennsylvania Experiment Station at State College is on this type of soil, and the many experiments conducted there apply directly to this type.

Yellow subsoil phase.—This of course is really a distinct soil type belonging to another series than the Hagerstown; but the extent of it is so limited that it has not seemed desirable to establish a new soil

type, especially in a reconnaissance survey. It is quite like any established soil derived from limestone, being rather too yellow for the Frederick, its nearest relation.

This soil differs from the Hagerstown silt loam in having a yellow, friable silty clay subsoil. Quartz fragments are noticeable, especially in the subsoil in some sections. The soil originated from the weathering of an impure shaley limestone, called the McSherrystown limestone. In places particles of shale are found throughout the 3-foot section. Outcrops of limestones are uncommon owing apparently to the deep weathering of the parent rock. At Midway and west of Brushtown very small bodies of a sandy loam soil have been included with this phase. These areas together would not comprise more than 4 or 5 acres. The sandy loam is underlain by a stratum of quartz sand, which is being quarried. This sandy soil, also, represents an entirely distinct type of soil—one that has not been mapped—unless it can be considered as constituting Morrison sandy loam.

This yellow subsoil limestone type occupies the nearly flat to slightly undulating area in the southeastern corner of the county between Littlestown and Hanover. It is well drained and seems to equal the best Hagerstown silt loam in productivity, being adapted to the same crops and seemingly requiring the same kind of treatment.

Colluvial phase.—This phase differs from the typical Hagerstown silt loam in that the surface soil seems to consist largely of colluvial material accumulated by wash and gravitational creep from the adjacent higher areas of Ashe and Porters soils. Partially rounded metarhyolite and quartz gravel are scattered over the surface. This accumulated brown silt loam surface is usually very deep, extending in many places to depths of 12 to 20 inches. The subsoil seems to consist of typical residual, red limestone material.

The topography is nearly flat to slightly undulating. This kind of soil has been mapped only in the vicinity of Fairplay. Agriculturally, the soil seems to be about equal to the adjacent typical Hagerstown silt loam. The numerous gravel present make it a little more difficult to cultivate, yet they impart a degree of friability not to be despised in a soil, especially for crops requiring nearly perfect underdrainage.

Ashe Stony Loam.

The Ashe stony loam differs from the Ashe gravelly loam principally in containing a much larger proportion of large stones. As a matter of fact, the stone content is so great that the type has not been cleared to any important extent and consequently, the surface layer differs somewhat from that of the cultivated areas of Ashe gravelly loam. There is an inch or so of leaf mold, that is, dead and decaying vegetation such as leaves, twigs, etc. Directly beneath this there

is frequently present a gray to almost white layer of silt loam extending to a depth of 3 to 4 inches, passing at this depth abruptly into pale-yellow silt loam which grades at about 10 to 12 inches into pale-yellow, friable silty clay loam to clay. Fragments of the metarhyolitic parent rock are abundant over the surface and throughout the soil and subsoil. In many places the light-colored surface layer is absent.

The type occupies large areas along the eastern foot hills of South Mountain, where it is associated with the Ashe gravelly loam and the Porters soils. It occupies the steeper, rougher areas of the locality. It includes, as mapped, some rough stony land and some small areas of Ashe gravelly loam. There are 11,136 acres, according to reconnaissance mapping.

The characteristic growth consists of chestnut (most of which has been killed by blight), chestnut oak, black oak, red oak, and other oaks, white pine, and on the lower slopes, hemlock, beech, and black locust. The undergrowth is made up largely of mountain laurel, huckleberry, witch-hazel, grape, ferns, and alder.

The agricultural value of this land is very low because of its stoniness and rough topography. Much of it is so deep that it should never be cleared, but used instead for forestry. Part of the type could be converted into fields equal in productiveness to the Ashe gravelly loam, by simply clearing off the timber and the larger stones.

Ashe Gravelly Loam.

The Ashe gravelly loam is a yellowish-brown or grayish-brown silty loam to silt loam, passing at depths ranging from about 8 to 12 inches into yellow, friable silty clay loam, grading in many places into friable, yellow silty clay. The gravel consists of partly-weathered, dove-colored schist fragments, increasing in quantity with increase in depth. The lower portion of the 3-foot section in places consists entirely of grayish disintegrated rock. In places large lumps of vein quartz are seen, and northwest of Brady School where rhyolitic breccia forms the bed rock, angular fragments of the breccia are scattered over the surface and the area which has been included with this type. In Buchanan Valley the long narrow belts of soil derived from sericite schist have been included with the Ashe gravelly loam because of their limited area. Where seen the soil of this inclusion consists of a brown silt loam with a subsoil of disintegrated whitish or light gray rock. Included with the type as mapped are small bodies of Porters gravelly loam, Porters stony loam, and Ashe stony loam.

The type occupies rolling hilly country, together with many gently sloping areas in the eastern foothills of South Mountain. It is well drained and the numerous rock fragments hold the material against serious erosion through its effect upon the absorptive capacity of the

soil, making the soil open and capable of taking up a large quantity of rainfall. Some areas on extremely steep hillsides have been cut up by deep gullies.

There have been mapped, together with the minor types and inclusions, 28,224 acres of this grade of land in Adams County. Much of this type has been cleared and is being cultivated. The timbered areas support a second or third growth similar to that of the Ashe stony loam.

Corn, wheat, hay, and oats are the main crops. The agriculture of the region occupied by this soil does not seem to be very flourishing, due, no doubt, to distance from shipping points, as well as to the rough topography, which militates against the most economical and profitable utilization of farm machinery. Many fields are in permanent pasture, and hay is sometimes cut from the same field for several years. Many surprisingly good fields of corn and wheat were seen, showing that with proper management this soil is anything but poor. The steeper slopes probably are best adapted to forestry and grazing. Considering the large pasture acreage, the section seems to be very much understocked. Some farmers have fair-sized dairies and some raise a limited number of horses, mules, and beef cattle; yet their industries are relatively unimportant. It would appear that with the large area available of relatively cheap pasture land it would pay to raise beef cattle and either sell them to the lowland farmers to finish or else finish them on the farm where they were born.

This soil is esteemed for apple and peach production, and many large thrifty commercial orchards have been established on it. Undoubtedly, the time will come when this soil, where the location is favorable, will be largely devoted to apple production, as that is likely to prove the most profitable crop in the long run.

Porters Gravelly Loam.

The Porters gravelly loam is a brown, grayish-brown, or yellowish-brown silt loam about 8 to 12 inches deep, overlying reddish-yellow friable silty clay loam, which passes beneath into dull-red, friable clay. The greater part of the type is derived from a green stone described as metabasalt—a metamorphosed basalt locally called "Copper stone." Small fragments of this rock are scattered over the surface of the type and disseminated through the soil and subsoil. Many of the steeper, rougher areas included with this type on the reconnaissance soil map would, on a more detailed map, be classed as Porters stony loam, while the small areas that are nearly free from stones would be classed as Porters silt loam.

The Porters gravelly loam is associated with the Ashe gravelly loam in the north-central and central parts of the county. It occupies rolling country along the eastern slopes of South Mountain. There are 20,608 acres of the type, according to the reconnaissance map.

The type is a good deep soil, which because of its friable, heavy subsoil is both well drained and retentive of moisture. These characteristics coupled with the fact that it occurs on high land, make this one of the most valuable soils in the county for raising fruit. It supports large commercial apple and peach orchards. The rougher areas are still timbered with chestnut, chestnut oak and other oaks, dogwood, butternut, locust, and maple, with an undergrowth of witch-hazel, mountain laurel, and huckleberry. The cleared areas, aside from the production of fruit, make excellent yields of the general-farm crops where handled properly. The numerous stones in the soil make it possible to cultivate very steep hillsides, which otherwise would wash badly. Aside from the orchards the type as a whole does not appear to be receiving the attention its productivity merits. This is due to the fact that many of the largest areas occur in rather inaccessible places. As a rule, the type is handled in very much the same way as the Ashe gravelly loam. The yields seem to be a little better.

Porters Stony Loam.

The Porters stony loam differs from the Porters gravelly loam chiefly in the presence of an abundance of loose large fragments of the parent rock scattered over the surface and buried or partly buried in the soil.

There are also outcrops of the bed rock or rock in place. The slopes are steep, and this fact together with the stony nature make this soil better suited to forestry than to any other purpose—at least, such is the case with much of it. It is a valuable forest soil.

The type occurs in the southwest corner of the county, the principal body lying on the Maryland-Pennsylvania line south of the Waynesboro road and west of Friends Creek. Only 2,368 acres have been mapped.

Dekalb Stony Loam.

The Dekalb stony loam beginning beneath 1 or 2 inches of leaf mold consists of white or gray sand, loamy sand, or gritty loam to a depth varying from about 2 to 5 inches below the surface. This overlies a friable yellow, gritty loam extending to a depth of about 3 feet or more with little change, except that there is perhaps a little more clay in the lower subsoil. In places directly beneath the gray layer, there is a thin brown, coffee-brown, or yellowish-brown layer. Large and small fragments of quartzite or sandstone are scattered over the surface and occur in the soil and subsoil in such quantity as to make is difficult or imposible to bore into the soil with a soil auger. Bed rock outcrops in places on mountain slopes. The gray surface layer is not everywhere present.

The type as mapped includes small bodies of Dekalb stony sandy loam, Dekalb loam, and some Rough stony land. Without minor inclusions 27,712 acres are shown on the soil map.

The Dekalb stony loam is found on the top of South Mountain along the western border of the county and on the crest of Pigeon Hill on the eastern border. It occurs on the flat tops of mountains and on the steep sides, having a general range of elevation from 1,000 to 2,100 feet above sea level. It is well drained to excessively drained.

The type, owing to its rough topography, difficulty of access, stony and somewhat droughty nature, has not been developed to any important extent. Probably 99 per cent of it is not cleared and great tracts are held by the State Department of Forestry. It is covered with a second growth of oaks, especially chestnut oak, chestnut, some pitch pine and a dense undergrowth of huckleberry, with less abundant sweet fern, sassafras, partridge pea, and mountain laurel.

The agricultural possibilities will depend largely upon the building of roads and the more nearly complete utilization of other more accessible soils of the county. Only the more nearly level areas should be cultivated; the very stony areas and the slopes constitute forest land, and it would be folly to attempt to cultivate them. With proper management the more favorable areas of this soil can be made to produce fair to good yields of the general-farm crops. Lime, fertilizer or manure, and short rotations will be essential to success. The experiments conducted on similar soils at Snow Shoe in Centre County by the Pennsylvania State College prove that this land can be made to maintain blue grass and white clover pastures as well as to produce fair yields of the general-farm crops. Potatoes and late vegetables and many varieties of apples are grown on this soil in other parts of the State. This soil needs to have humus-supplying crops, preferably the legumes, grown on it and plowed under at frequent intervals.

Berks Shale Loam.

The Berks shale loam consists of a brown shaly silt loam passing at about 10 to 12 inches into yellow shaly silty clay loam. The thin platy shale fragments increase in quantity with increase in depth, and usually the soil grades into a mass of partly weathered shale fragments at a depth ranging from about 15 to 30 inches. The shale is closer to the surface on the shoulders of the hills than elsewhere. It outcrops south of Mt. Pleasant along the York County line. Some areas of Berks silt loam have been included with the shale loam. The large area in the southeastern part of the county just north of the Manor slate loam differs from the typical Berks shale loam in containing some angular quartz fragments mixed with an abundance of shale fragments.

The Berks shale loam in Adams County is of limited extent, only 4,672 acres having been mapped. A number of narrow belts of it occur in the vicinity of Edgegrove and an important area occurs just south of Sells Station and Mt. Pleasant. It has a characteristic billowy topography, comprising numerous well-rounded ridges and hills. The type is well drained to excessively drained. Those bodies in which the shale bedrock comes close to the surface are of an extremely droughty nature.

The Berks shale is nearly all cleared and under cultivation. It is being handled in about the same manner as the Manor slate loam. This is the soil type which in Lehigh and Northampton counties is looked upon as one of the best potato soils in the State, if not the best. It also produces excellent crops of alfalfa, and, where the shale is not too close to the surface, it is a very productive soil, admirably adapted to the production of corn, wheat, clover, and timothy.

Bermudian Silt Loam.

The Bermudian silt loam is a chocolate reddish-brown or brownish Indian-red silt loam, underlain by chocolate reddish-brown to Indian-red or chocolate-red silt loam to silty clay loam. The lower few inches of the 3-foot section frequently consists of sandy loam, loamy sand or sand. Pockets or strata of sand may be present through the vertical section and small sandy patches occur here and there through the type. In places, as along the outer edges of some of the bottoms, the subsoil is mottled gray and yellow. This mottling is the impress of poor underdrainage, and its presence points to tiling or ditching as one of the principal needs of such areas.

The type is a first-bottom soil consisting largely of alluvium derived from the Penn and Lansdale soils. It occurs along the streams which drain the soils derived from the Triassic rocks. The largest and widest bottoms occupied by this type are along Bermudian, Conewago, and Marsh Creeks and their tributaries. Considering the type as a whole it is exceptionally well drained for a first-bottom soil, but it is subject to overflow during periods of excessive rainfall, especially where it borders the smaller streams. Together with inclusions 13,440 acres have been mapped.

Most of this soil has been cleared of the native growth of willow, sycamore, pin oak, elm, shagbark hickory, ash, and alder, except the strips along the stream banks. Only a few of the larger areas are under cultivation. Where cultivated very good yields of the general-farm crops are obtained, provided much damage is not done by overflows. The type finds its chief use for pasturing dairy cows, and, because of the nearness of the water table to the surface, it supports very good pasture plants, which remain green even during the driest season.

Wehadkee Silty Clay Loam.

The Wehadkee silty clay loam is characterized by a grayish-brown or brownish-gray silty clay loam surface soil and a light-gray, of bluish-gray, stiff plastic clay subsoil, which is found within 5 or 6 inches of the surface. In places, as on Marsh Creek near Knoxlyn, gravel from crystalline rocks is encountered in the lower subsoil. Some water-worn gravel and cobbles and an occasional boulder are found in many places on the surface and throughout the soil and subsoil. The type as mapped is variable in texture; in places it is almost sandy, but the rather large area northwest of Arendtsville is a silt loam consisting of a gray to brownish-gray silt loam 5 to 10 inches deep, overlying very light-gray silt loam with some yellow mottling. This passes down into bluish-gray plastic clay with some yellow mottling and containing fragments of quartzite and other rocks.

The Wehadkee silty clay loam occurs as a first-bottom type along those streams which drain areas occupied by soils derived from crystalline rocks. The type occurs in many places in the county, but in no place are the bottoms very wide. Some of the most important areas are those along the headwaters of the Conewago Marsh, and Latimore creeks. The map shows 5,120 acres.

The type is poorly drained. Much of it has not been cleared. The native growth consists chiefly of willow, poplar, sycamore, elm and hickory. This land is used chiefly for pasture. The silt loam area near Arendtsville had a good stand of corn on it. When rain is moderate and evenly distributed, corn does fairly well, but the crop suffers in very wet and in very dry seasons. Overflows do some damage. Internal movement of moisture is usually slow in light-colored soils of this kind in the humid region during dry weather. Grass for hay and pasturage is probably the best crop for average conditions on this type of soil. Ditching followed by liberal liming undoubtedly would improve this soil so that the legumes could be grown with better success, and probably also other crops.

Birdsboro Silt Loam.

The typical Birdsboro silt loam is an Indian-red or chocolate-red to chocolate reddish-brown, mellow silt loam, underlain at about 6 to 8 inches by Indian-red or chocolate-red silty clay. In many places sandy layers are encountered in the extreme lower subsoil and beds of gravel are present in some areas. In some places, as near McKnightstown, bedded shale is close to the surface, and the subsoil appears to be partly residual. The area mapped along Conewago Creek northeast of Woodside School differs from the typical soil in having a yellow subsoil, and it would be classed as Holston on a more detailed map, the component material having been washed mostly from noncalcareous sandstone and shale soils. Some quartz and quartzite gravel are present in places.

The type represents wash largely from the Penn silt loam. It occurs on second-bottom positions, and no longer is subject to overflow, except in some of the lower areas during exceptionally high water. It is found in many places along the streams in the Piedmont or eastern half of the county. Some of the most important areas are those along and just south of Marsh Creek between Seven Stars and Cashtown, along Conewago Creek near Beechersville, Table Rock, Aldheim, and East Berlin. The soil is naturally well drained, and has a nearly level surface, which drops off suddenly on the stream side to the first-bottom or lower bottom of the stream. The map shows 5,824 acres of the type.

The Birdsboro silt loam is practically all cleared and is being used principally for the production of the general-farm crops common to the section. A common rotation that is being practiced by many farmers operating on this soil is corn, followed by wheat, and the wheat by timothy and clover. The corn comes off in time to seed wheat late. Some farmers modify this rotation by sowing oats the year after corn and many cut the grass for two years. Average yields are: corn, 35 to 40 bushels per acre; wheat, 12 to 15 bushels; and hay, 1½ to 2 tons. Beef cattle are fed during the winter months by many farmers, and others maintain dairies of 10 to 15 cows the year around. Poultry and hogs are kept in sufficient numbers to supply the home needs.

As a rule, the farms on this soil appear to be well cared for. Most farmers apply some fertilizer to both corn and wheat, and manure is used in addition on the corn land. Lime is used occasionally.

The Birdsboro silt loam is one of the most productive soils in the county. Its nearly level surface, mellow structure, and good depth make it easy to cultivate and offer the opportunity to use the most modern types of labor-saving machinery. It responds very well to good treatment. More attention should be given to the proper use of fertilizer and lime.

Altavista Silt Loam.

The Altavista silt loam is a grayish-brown silt loam to a depth of about 8 inches, where the soil grades into yellow silty clay loam, mottled with gray or bluish gray, and this, in turn, passes at about 15 inches into heavy, plastic clay mottled gray and yellow. Some areas of a better-drained soil, with a yellow clay subsoil, have been included with this type, as mapped. Some water-worn gravel of crystalline rock are scattered over the surface and disseminated through the 3-foot section.

The Altavista silt loam is a second-bottom soil, representing material deposited by streams draining areas of soils derived from crystalline rock. It occurs in small areas on flats a few feet above the

present flood plains along streams in or flowing from South Mountain, Pigeon Hill, the trap rock ridges, or land underlain by schist in the southeastern part of the county. Only a few areas in Adams County were large enough to map. The most important of these are at Knoxlyn near the junction of Marsh Creek and Muskrat Run, and east of Seven Stars.

The type is unimportant in extent as well as in agricultural value. It requires draining in most places before it is suited for any purpose, except for the growing of pasture grasses. Much of it is still in timber. It is best suited to hay and for pasturing stock. Wheat will do fairly well, but while succeeding in years of evenly distributed and plentiful rainfall, it is likely to yield poorly in wet as well as in dry years. The soil hardens on drying. For best results, in addition to drainage it needs an abundance of manure or vegetable matter plowed under, lime, and fertilizer, especially phosphatic fertilizers.

Elk Silt Loam.

The Elk silt loam consists of a brown, mellow silt loam about 10 to 12 inches deep, overlying yellow silty clay loam of a friable nature, which passes quickly into a yellow friable silty clay. The lower portion of the 3 foot section is usually somewhat coarser in texture than the upper sub-soil, and in places layers of sandy loam or sand are encountered in this lower part. Where the lower subsoil is heavy it is possible that the material or a part of it is derived directly from the underlying limestone. Rounded and subangular gravel of quartz, quartzite and sandstone are present in limited quantity through the soil and subsoil and are scattered over the surface. A poorly drained area about half a mile southeast of Brushtown, consisting of a grayish-brown silt loam, with a mottled yellow and gray heavy clay subsoil, has been included with this type.

The Elk silt loam is a second-bottom soil which is derived largely or in part from alluvium washed from limestone uplands. In Adams County it occurs only in the southeastern part of the county along the South Branch of Conewago Creek. It is found on a terrace a few feet above the first bottom and is well drained. Only 1,024 acres have been mapped.

The Elk silt loam is one of the very strongest soils in the county, and is very similar, in so far as crop adaptations, requisite methods of management, and value are concerned, to the adjacent residual limestone soil mapped as the Hagerstown silt loam.

Holly Silt Loam.

The Holly silt loam is a gray to yellowish-gray silt loam to silty clay loam, which passes at about 6 to 8 inches into yellowish-gray silty clay. The subsoil is stiff and impervious and becomes lighter

gray with depth. In places the subsoil is a mottled yellow and gray silty clay loam, and in other places it is a bluish-gray to dark-blue silty clay loam, with rusty-brown mottling, underlain by plastic bluish-gray silty clay with rusty-brown mottlings. Along the small streams below Bittinger the surface soil is a dark bluish-gray or dark-blue silty clay loam, with rusty-brown mottling, passing down into dark-blue plastic silt clay which is also mottled with rusty brown. This phase approaches the characteristics of the soil known as Dunning silt loam, but it has been included with the Holly, owing to its limited extent.

The Holly silt loam is a poorly drained, first-bottom, alluvial soil, which owes its origin to wash from upland soils including some limestone soil. It is subject to overflow during periods of high water, from which overflow water additional sediments are laid over the surface.

The Holly silt loam is of limited extent in Adams County, the 1,472 acres having been mapped in a narrow belt in the southeastern part, along the South Branch of Conewago Creek. It has been cleared of its native water-loving tree and undergrowth and is being used largely for pasture. It has much the same characteristics as the Wehadkee silt loam, and the same crop adaptations, and probably about the same requirements for improvement. Its chief difference from the Wehadkee and other light-colored first-bottom alluvial soils of the humid region, is the presence of material derived from limestone.

SUMMARY.

The present dominant type of agriculture in Adams County is the growing of the general-farm crops of corn, wheat, and hay. In many sections dairying and the feeding of beef cattle are important industries. The milk is usually shipped to Baltimore or Washington.

Adams County is the foremost apple county in the State of Pennsylvania. Among the most popular varieties are the York Imperial, Stayman Winesap, and Grimes Golden.

Peaches are also grown extensively, although they are usually planted as fillers in the apple orchards.

Vegetables, especially peas and sweet corn, are grown extensively in the southeastern part of the county.

Farmers as a rule have recognized the crop adaptations of the different soils, at least to a considerable degree, and they are generally adjusting their systems of agriculture to meet or partly meet the adaptation requirements, as much as seems practicable. Their methods of tillage and of handling crops are prevailingly good.

The soils of Adams County for the most part are derived from the underlying rocks, which are both sedimentary and crystalline in

character. The character of the soils has a close relationship to the parent rock; at least, the distinct types of rock give rise to distinct kinds of soils, although in some cases the soil material formed through the decay of rocks has been altered by poor drainage, giving rise to soils quite different from the normal well-drained soil derived from that type of rock. For example, the Penn and Croton soils, both of which are derived from red Triassic shales, are very different.

Four broad soil region or provinces are comprised in the county, viz., the Appalachian Mountains, the Piedmont Plateau, the limestone valleys, and the river flood plains. Twenty series of soils have been recognized, including 23 types and 2 phases.

The Porters and Ashe gravelly loams are considered the most popular apple soils of the Appalachian Province, and they are also good general-farming soils where the topography is favorable. The Dekalb and Ashe stony loams are uncleared for the most part, owing to their rough and stony character as well as to their rather inaccessible location. They are largely best adapted to forestry. The Berks shale loam is of small extent, but with the exception of the very thin or shallow areas it is recognized as a strong vegetable and general-farming soil.

The Penn and Lansdale silt loams are very popular general-farming soils of the Piedmont Province, and the Penn gravelly loam and the Montalto soils are recognized as being exceptionally good soils for the production of apples and peaches. The Herndon and Edgemont are also good fruit soils, especially for peaches and apples.

The Manor slate loam is the most important truck soil in the county, and with good management it gives profitable results. The Croton and Watchung soils are used largely for pasture and must be drained for the successful production of cultivated crops.

The Hagerstown silt loam is one of the very strongest corn, wheat, clover, timothy, and alfalfa soils in the county. The two phases mapped in addition to the typical soil are nearly if not quite as fertile as the typical soil.

The various bottom soils—alluvial soils—vary considerably in crop adaptation, depending upon their position in reference to overflows and upon the drainage condition between overflows. The Birdsboro and Elk are second-bottom, old alluvial soils, which are recognized as being especially well suited to the production of the general-farm crops of the section, while the Altavista is a second-bottom soil that requires draining.

The Bermudian is the most extensive of the first-bottom soils, and is fairly well drained. The other first-bottom soils, the Wehadkee and Holly, are rather poorly drained. These are also subject to periodical overflows, and consequently all three of them find their use in providing pastures for dairy cattle.